CLAIMS

WHAT IS CLAIMED IS:

1. A method comprising:

calculating tension for a segment of a web material in real time, the segment of the web material being a tension zone; and

controlling a first actuator control signal for a first roller as a function of the tension in the tension zone.

2. The method according to claim 1, wherein the method further comprises:

controlling a second actuator control signal for a second roller as a function of the tension in the tension zone.

3. The method according to claim 2, wherein the tension zone corresponds to the segment of web material between the first roller and the second roller;

the first roller being driven at a first desired velocity by the first actuator control signal; and

the second roller being driven at a second desired velocity by the second actuator control signal.

4. The method according to claim 1, where calculating a tension for a segment of web material comprises:

determining an unstrained length of the web material added to the tension zone in a time period, the time period having a beginning and an end; and

determining the tension in the web material at the end of the time period as a function of the unstrained length of web material added to the tension zone.

5. The method of claim 4, wherein calculating a tension for a segment further comprises:

determining an unstrained amount of the web material in the tension zone at the beginning of the time period; and

determining the tension in the web material at the end of the time period as a function of the unstrained amount of web material added to the tension zone and the unstrained amount of web in the tension zone at the beginning of the time period.

6. The method of claim 5, wherein calculating a tension for a segment further comprises:

determining an unstrained amount of the web material subtracted from the tension zone in the time period; and

determining the tension in the web material at the end of the time period using the unstrained amount of web material added to the tension zone, the unstrained amount of web material in the tension zone at the beginning of the time period, and the unstrained amount of web material subtracted from the tension zone.

7. The method according to claim 6, wherein the determining the tension in the web material at the end of the time period comprises:

combining the unstrained amount of the web material added to the tension zone, the unstrained amount of the web material in the tension zone at the beginning of the time period, and the unstrained amount of web material subtracted from the tension zone to determine an amount of web material in the tension zone at the end of the time period;

dividing the amount of the web material in the tension zone at the end of the time period by a length of the tension zone to determine a current strain for the web material; and

converting the strain for the web material to tension.

8. The method of claim 1, wherein calculating a tension further comprises:

receiving a position signal from a position sensor, wherein the position signal indicates a position of the first roller; and

calculating the tension in real-time as a function of the position signal.

9. The method according to claim 4, further comprising:

receiving a position signal from a position sensor, wherein the position signal indicates a position of the first roller, and

wherein determining the unstrained amount of the web material comprises determining the unstrained amount of web material added to the tension zone as a function of the position of the first roller and a tension value for an upstream tension zone.

10. The method according to claim 4, wherein the unstrained amount of web material in the tension zone is determined using a previously determined tension value for the tension zone.

11. The method according to claim 4, wherein the unstrained amount of web material added to the tension zone is determined using a position of the second roller and a previously determined tension value for the tension zone.

12. The method according to claim 4, wherein the tension in the tension zone at the end of the time period is used to determine an amount of web material added to a downstream tension zone.

13. The method according to claim 12, wherein the method further comprises:

calculating a tension for the web material in the adjacent downstream tension zone by:

determining an unstrained amount of the web material added to the adjacent downstream tension zone in the time period, the time period having a beginning and an end;

determining an unstrained amount of the web material in the adjacent downstream tension zone at the beginning of the time period;

determining an unstrained amount of the web material subtracted from the adjacent downstream tension zone in the time period;

determining the tension in the web material at the end of the time period using the unstrained amount of web material added to the adjacent downstream tension zone, unstrained amount of web material in the adjacent downstream tension zone, and unstrained amount of web material subtracted from the adjacent downstream tension zone.

14. A method comprising:

receiving a position signal indicating a position of a first roller in a manufacturing system for a web material;

calculating a change in length of the web material within a zone defined by the first roller and a second roller based on the position signal; and

calculating a property of the web material based on the change in length, and

outputting the calculated property of the web material.

15. The method according to claim 14, wherein the outputted calculated property is displayed to an operator.

16, The method according to claim 14, wherein the method further comprises;

controlling an actuator control signal based on the calculated property of the web material.

17. The method according to claim 16, wherein the actuator control signal varies the velocity of the first roller.

18. The method according to claim 16, wherein the actuator control signal varies the velocity of the second roller.

19. The method according to claim 16, wherein the actuator control signal varies a span length between the first roller and the second roller.

20. The method of claim 14, wherein calculating a change in length comprises:

determining a change in position of the first roller over a period of time based on the position signal; and

calculating the change in length of the web material within the zone based on the determined change in position of the first roller.

21. The method of claim 14, wherein the property comprises one of a tension of the web material, a modulus for the web material, a width of the web material, or a thickness of the web material.

22. The method of claim 14, wherein calculating a property comprises:

determining an unstrained amount of the web material added to the tension zone in a time period, the time period having a beginning and an end;

determining an unstrained amount of the web material in the tension zone at the beginning of the time period;

determining an unstrained amount of the web material subtracted from the tension zone in the time period;

combining the unstrained amount of web material added to the tension zone, unstrained amount of web material in the tension zone, and unstrained amount of web material subtracted from the tension zone to determine an amount of web material in the tension zone at the end of the time period; and

dividing the amount of web material in the tension zone at the end of the time period by the length of the tension zone to determine a current strain for the web material; and

converting the strain for the web material to the property.

23. The method according to claim 22, wherein the unstrained amount of web material added to the tension zone is determined using a position of the first roller and a tension value for an adjacent upstream tension zone at the end of the time period.

24. The method according to claim 22, wherein the unstrained amount of web material in the tension zone is determined using a previously determined tension value for the tension zone at the beginning of the time period.

25. The method according to claim 22, wherein the unstrained amount of web material added to the tension zone is determined using a position of the second roller and a previously determined tension value for the tension zone at the beginning of the time period.

26. The method according to claim 22, wherein the tension in the tension zone at the end of the time period is used to determine an amount of web material added to an adjacent downstream tension zone.

27. The method according to claim 26, wherein the method further comprises:

calculating a tension for the web material in the adjacent downstream tension zone by:

determining an unstrained amount of web material added to the adjacent downstream tension zone in a time period, the time period having a beginning and an end;

determining an unstrained amount of web material in the adjacent downstream tension zone at the beginning of the time period;

determining an unstrained amount of web material subtracted from the adjacent downstream tension zone in the time period;

determining the tension in the web material at the end of the time period using the unstrained amount of web material added to the adjacent downstream tension zone, unstrained amount of web material in the adjacent downstream tension zone, and unstrained amount of web material subtracted from the adjacent downstream tension zone.

28. A computer-readable medium comprising instructions for causing a programmable processor to:

receiving a first position corresponding to a position of a first roller;

receiving a second position corresponding to a position of a second roller; and

calculating a parameter for a segment of web material in real time using the first position and the second position.

29. The computer-readable medium according to claim 28, wherein the calculating a parameter for a segment of web material comprises:

determining an unstrained amount of web material added to the tension zone in a time period, the time period having a beginning and an end;

determining an unstrained amount of web material in the tension zone at the beginning of the time period;

determining an unstrained amount of web material subtracted from the tension zone in the time period; and

determining the parameter of the web material at the end of the time period using the unstrained amount of web material added to the tension zone, unstrained amount of web material in the tension zone, and unstrained amount of web material subtracted from the tension zone.

30. The computer-readable medium according to claim 29, wherein the determining the parameter of the web material at the end of the time period comprises:

combining the unstrained amount of web material added to the tension zone, unstrained amount of web material in the tension zone, and unstrained amount of web material subtracted from the tension zone to determine an amount of web material in the tension zone at the end of the time period;

dividing the amount of web material in the tension zone at the end of the time period by a length of the tension zone to determine a current strain for the web material; and

converting the strain for the web material to the parameter.

31. The computer-readable medium according to claim 28, wherein the unstrained amount of web material added to the tension zone is determined using a position of the first roller and a parameter value for an adjacent upstream tension zone at the end of the time period.

32. The computer-readable medium according to claim 28, wherein the unstrained amount of web material in the tension zone is determined using a previously determined parameter value for the tension zone at the beginning of the time period.

33. The computer-readable medium according to claim 28, wherein the unstrained amount of web material added to the tension zone is determined using a position of the second roller and a previously determined parameter value for the tension zone at the beginning of the time period.

34. The computer-readable medium according to claim 28, wherein the parameter of the tension zone at the end of the time period is used to determine an amount of web material added to an adjacent downstream tension zone.

35. The computer-readable medium according to claim 34, wherein the method further comprises:

calculating a parameter for the web material in the adjacent downstream tension zone by:

determining an unstrained amount of web material added to the adjacent downstream tension zone in a time period, the time period having a beginning and an end;

determining an unstrained amount of web material in the adjacent downstream tension zone at the beginning of the time period;

determining an unstrained amount of web material subtracted from the adjacent downstream tension zone in the time period;

determining the parameter of the web material at the end of the time period using the unstrained amount of web material added to the adjacent downstream tension zone, unstrained amount of web material in the adjacent downstream tension zone, and unstrained amount of web material subtracted from the adjacent downstream tension zone.

36. A system comprising:

at least two position sensors generating respective position signals, each position sensor being coupled to a respective roller in a web transport system;

a controller module that calculates a tension for web material based upon the two position signals, and outputs an actuator control signal based upon the calculated tension.

37. The system of claim 36, wherein the controller module calculates the tension for the web material in a tension zone formed by the rollers coupled to the at least two position sensors.

38. The system according to claim 36, wherein the controller module calculates the tension in the web material by:

determining an unstrained amount of web material added to the tension zone in a time period, the time period having a beginning and an end;

determining an unstrained amount of web material in the tension zone at the beginning of the time period;

determining an unstrained amount of web material subtracted from the tension zone in the time period; and

determining the tension in the web material at the end of the time period using the unstrained amount of web material added to the tension zone, unstrained amount of web material in the tension zone, and unstrained amount of web material subtracted from the tension zone.

39. The system according to claim 38, wherein the determining the tension in the web material at the end of the time period comprises:

combining the unstrained amount of web material added to the tension zone, unstrained amount of web material in the tension zone, and unstrained amount of web material subtracted from the tension zone to determine an amount of web material in the tension zone at the end of the time period;

dividing the amount of web material in the tension zone at the end of the time period by a length of the tension zone to determine a current strain for the web material; and

converting the strain for the web material to tension.

40. The system according to claim 39, wherein the unstrained amount of web material added to the tension zone is determined using a position of the first roller and a tension value for an adjacent upstream tension zone at the end of the time period.

41. The system according to claim 39, wherein the unstrained amount of web material in the tension zone is determined using a previously determined tension value for the tension zone at the beginning of the time period.

42. The system according to claim 39, wherein the unstrained amount of web material added to the tension zone is determined using a position of the second roller and a previously determined tension value for the tension zone at the beginning of the time period.

43. The system according to claim 39, wherein the tension in the tension zone at the end of the time period is used to determine an amount of web material added to an adjacent downstream tension zone.